cutting or deposition—would seem to be coastal currents of some sort. Such currents must be either marine, or else subterranean streams from the land, and it does not seem altogether unlikely that they might be the latter. The emergence of subterranean streams might at least account, in some cases, for the absence of deposits in the valley heads and their nearness to the shore, if not for the formation of the valley as a whole. The occurrence of an oil well in Vincente valley near its head is significant in this connection. The larger pre-Pliocene valleys of the Pacific coast, which were much deeper than those of the present time, were filled to a greater or less extent during the Pliocene depression of the coast, and have been as yet only partially re-excavated. There are therefore at intervals along the coast, deposits of loose materials extending to a considerable depth below sea level, and through these, underground waters, under sufficient head, might find a submarine outlet.

It is possible that many if not most of the valleys are due, not to any one cause, but to several causes which have all contributed to their formation or preservation. Much careful and detailed investigation is necessary before the problem can be solved, and the statements made here are intended as suggestive rather than final. Such work as Professor Ritter reports gives valuable information. Observations in the vicinity of the valleys on surface currents, their strength, direction and persistence, and on the temperature and salinity of the surface waters, and also similar observations made, as far as possible, near the bottoms of the valleys and in their neighborhood, as well as a study of the materials covering their floors, might throw much light on the question of their origin. Further than this, detailed geological study of the mainland adjacent to the valleys is necessary. The physiographic conditions, both subaerial and submarine, have been taken into account, to a certain extent, in this discussion, but a fuller knowledge of them is needed. Finally, as has been stated elsewhere by the writer, each valley must be considered by itself, since the explanation for any one is not necessarily the explanation for all.

W. S. Tangier Smith.

Washington, D. C.

SHORTER ARTICLES.

HOW MANY ONE-DOLLAR BILLS WILL EQUAL IN WEIGHT A FIVE-DOLLAR GOLD PIECE?

If the reader will answer the above question in his own mind before going further he will better appreciate what follows. This question was asked of a number of students and professors, and the answers recorded. The answers were surprising and for the most part extravagant. It seems that the idea of value is so prominently associated with currency that definite ideas of weight are somewhat wanting, although most people have fairly correct ideas of the weight of paper in other forms. The number of persons answering the question was 97. The average estimate was 2,291 bills, the median estimate was 45. In order to see if there is any tendency to confuse the categories of value and weight unconsciously, other persons were asked to answer the question: How many five-dollar bills will equal in weight a five-dollar gold piece? Some were asked a similar question with reference to twenty-dollar bills. Putting the fives and twenties together, there were 74 answers given. The average estimate was 97, the median 25. The great difference in the averages is due to a half dozen very large answers to the first question, but these do not materially affect the median estimates, which are the really significant figures. The answers are all from males. A number of answers were given by female students, but their answers, either by chance or by nature, were of such a great variety—ranging from one to one million—that it seemed best to leave them out in making the comparison. After these calculations were made I received answers, through the kindness of Professor Templin, of the University of Kansas, from two divisions of a class of both sexes. The figures with reference to the one-dollar bills show an average of 2,749, and a median estimate of 99, while with the five-dollar bills the

average was 492, and the median 50. It is interesting to note that the ratio of the median estimates in the two sets is approximately the same. The number of bills actually required is a little less than seven.

J. FRANKLIN MESSENGER.
COLUMBIA UNIVERSITY.

RECENT PROGRESS IN PETROLOGY.

CHEMICAL CLASSIFICATION OF ERUPTIVE ROCKS.

OSANN, in a recent paper (Tschermak's *Min. u. petrographische Mitth.*, Bd. XX., pp. 399–588, 1901), has carried out with reference to the effusive rocks the principles of classification which in an earlier publication (*Ibid.*, Bd. XIX., pp. 351–470, 1900) he applied to the plutonic rocks. It is his avowed intention to discuss in a third contribution the application of the same principles to the dike rocks.

The chemical compositions of the rocks are expressed by the general formula

$$s_v a_w c_x f \, n_z$$

where

s = the molecule SiO_2.

a = the atomic group $(NaK)_2Al_2O_4$.

c = the atomic group $CaAl_2O_4$.

f = the atomic group (FeMnMgSrBaCa)O.

n = the proportion of soda molecules when the relative numbers of soda and potash molecules in the rock are calculated to a sum of 10.

v = the number of molecules of silica when the ordinary molecular ratios of the rock analysis are calculated to a sum of 100.

w, x and y = the proportions of each of their respective atomic groups, when all three are calculated to a sum of 20.

z = the numerical value of the soda proportion n.

In these two papers 207 analyses of plutonic and 403 analyses of effusive rocks are considered and the corresponding rock formulas calculated. From these formulas the rocks are plotted upon triangular projection paper, the elements of the projection being a, c and f.

The carrying out of this plan has involved much labor, and if the result is somewhat disappointing it has at least the full value of recording a careful and sustained experiment. It is to be regretted that the author has modestly restricted his attempt at classification to setting up types within the groups and families of the Rosenbusch classification. It is partly owing to this acceptance of a scheme which has grave objections and which is based on principles little in common with those on trial in this essay, that the latter falls short of more conclusive results. For example, it is seen that the formula of the 'Klausen type' of the diorites is identical with that of a granite intermediate between the 'Syene type' and 'Kamm type,' and similar cases are found among the formulas of the basaltic andesitic and allied rocks of the effusives.

Inspection of the diagrams fails to show any grouping of the effusive rocks upon which classification might be based. In the plutonic rocks the anorthosites alone show some tendency in the graphic projection to form a distinct family. The silica does not appear in the method of plotting here used, and the result is hardly so graphic and satisfactory as that employed by Brogger in his 'Ganggefolge des Laurdalits.'

GNEISSES OF THE SCHWARZWALD.

IN continuation of his studies of the crystalline metamorphic rocks of Baden, Rosenbusch (*Mitth. der Grossh. Badischen Geologischen Landesanstalt*, IV., pp. 367–395, 1901) gives detailed petrographical descriptions and chemical analyses of the para-augite and para-amphibole gneisses of the Schwarzwald, the prefix *para* signifying their derivation from former sediments. The augitic gneisses range from quartzose or psamitic types, to those free from quartz. It is concluded on chemical grounds, supported by geological relationships, that these gneisses have been formed by the metamorphism of calcareous sandstones, dolomitic calcareous shales and clayey marls. The hornblendic gneisses were derived from a ferruginous dolomitic marl containing quartz and rutile.

These interesting studies, which recall those